A Literature Survey on Computer Vision Towards Data Science

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Abstract: Computer Vision is the discipline under a broad area of Artificial Intelligence which teaches machines to see. From the biological science point of view, its aims are to come up with computational models of the human visual system. From the engineering point of view, computer vision aims to build autonomous systems which could perform some of the tasks which the human visual system can perform (and even surpass it in many cases). we see a major resurgence of interest in how machines 'see' and how computer vision can be used to build products for consumers and businesses. Few examples of such applications are- Amazon Go, Google Lens, Autonomous Vehicles, and Face Recognition. The goal of computer vision is to understand the content of digital images. Typically, this involves developing methods that attempt to reproduce the capability of human vision. [1] The purpose of this paper to brief about the technique behind the computer vision using Data Science. [2]
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Index Terms - Inroduction, History of Computer Vision, Existing Method, Proposed Method, Applications, Future Scop*e*

I. Introduction

Computer vision is an inter disciplinary field that deals with how computers can be made to gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do. "Computer vision is concerned with the automatic extraction, analysis and understanding of useful information from a single image or a sequence of images. It involves the development of theoretical and algorithmic basis to achieve automatic visual understanding." As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technological discipline, computer vision seeks to apply its theories and models for the construction of computer vision systems.[3]OpenCV (Open Source Computer Vision), a cross- platform and free to use library of functions is based on real time Computer Vision which supports Deep Learning frameworks that aids in image and video processing. In Computer Vision, the principal element is to extract the pixels from the image so as to study the objects and thus understand what it contains. Below are a few key aspects that Computer Vision seeks to recognize in the photographs:

➢ **Object Detection:** The location of the object.
➢ **Object Recognition:** The objects in the image, and their positions.
➢ **Object Classification:** The broad category that the object lies in.
➢ **Object Segmentation:** The pixels belonging to that object

II. History of Computer Vision

It is commonly accepted that the father of Computer Vision is Larry Roberts, who in his PhD .thesis (cir. 1960) at MIT discussed the possibilities of extracting 3D geometrical information from2D perspective views of blocks (polyhedra) Many researchers, at MIT and elsewhere, in Artificial Intelligence, followed this work and studied computer vision in the context of the blocks world[4] When computer vision started to take shape as a field in the 1960s, its aim was to try and mimic human vision systems and ask computers to tell us what they see, automating the process of image analysis. This kind of technology is the precursor to artificially intelligent image recognition. Before, any kind of image analysis had to be done manually, from x-rays to MRIs to hi-res space photography. Just like animals, computers "see" the world differently from us humans: basically, they count the number of pixels, try to discern borders between objects by measuring shades of color, and estimate spatial relations between objects.

As computer vision evolved, algorithms started to be programmed to solve individual challenges, and they become better at doing the job the more they repeat the task.Fast forward to 2010 (and beyond), we have seen an acceleration in improved deep learning techniques and technology. With deep learning, we're now able to program supercomputers to train themselves, self-improve over time

and provide portions of these capabilities to businesses as online applications, like cloud-based apps. In order for these machines to learn, they need to be fed data In a world where the biggest players like Facebook and Instagram limit how much of their content other actors are able to tap into, there's been a rise in open-source projects such as ImageNet. ImageNet's mission is to create a large-scale image database that researchers can tap into in order to train and manufacture their algorithms. The challenge is that in order for computers to index and catalogue these huge sets of data, they initially need to have some human input in terms tagging and classifying their 'training images'. Deep learning algorithms then use this information to create benchmarks to compare future images with, but need to be fed large quantities of training images, as many as 10s of millions
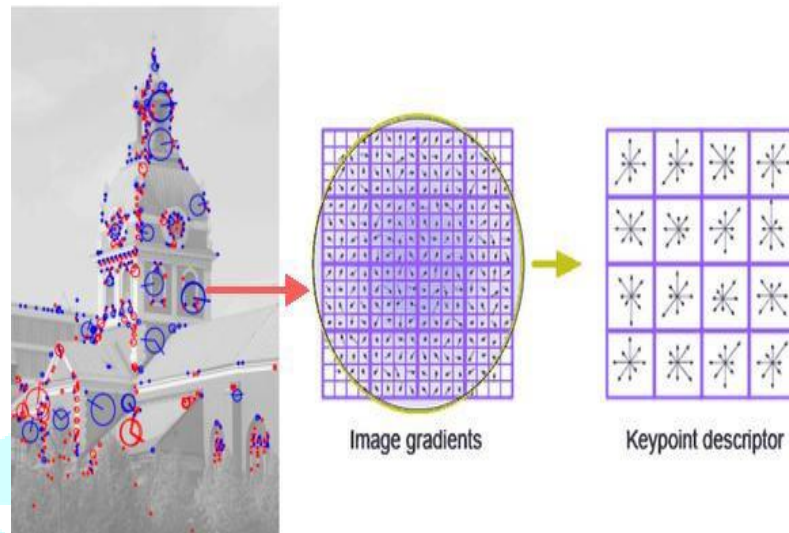
III. Existing Method

Fig 1:- Traditional way of Feature Extraction

Computer vision can be succinctly described as finding and telling features from images to help discriminate objects and/or classes of objects. Computer vision has become one of the vital research areas and the commercial applications bounded with the use of computer vision methodologies is becoming a huge portion in industry. The accuracy and the speed of processing and identifying images captured from cameras are has developed through decades. Being the well-known boy in town, deep learning is playing a major role as a computer vision tool. Computer vision was mainly based with image processing algorithms and methods. The main process of computer vision was extracting the features of the image. Detecting the color, edges, corners and objects were the first step to do when performing a computer vision task. These features are human engineered and accuracy and the reliability of the models directly depend on the extracted features and on the methods used for feature extraction. In the traditional vision scope, the algorithms like SIFT *(Scale-Invariant Feature Transform),* SURF *(Speeded-Up Robust Features),* BRIEF *(Binary Robust Independent Elementary Features)* plays the major role of extracting the features from the raw image.

The difficulty with this approach of feature extraction in image classification is that you have to choose which features to look for in each given image. When the number of classes of the classification goes high or the image clarity goes down it's really hard to cope up with traditional computer vision algorithms.[6]

IV. Proposed Method

Deep learning, which is a subset of machine learning has shown a significant performance and accuracy gain in the field of computer vision. Arguably one of the most influential papers in applying deep learning to computer vision, in 2012, a neural network containing over 60 million parameters significantly beat previous state-of-the-art approaches to image recognition in a popular Image Net computer vision competition. The boom started with the convolutional neural networks and the modified architectures of ConvNets. By now it is said that some convNet architectures are so close to 100% accuracy of image classification challenges, sometimes beating the human eye!

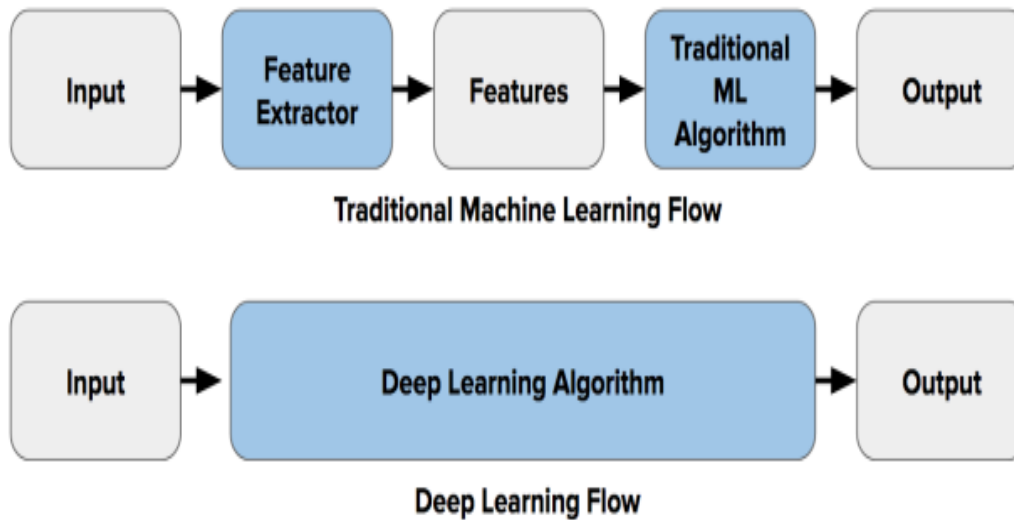The main difference in deep learning approach of computer vision is the concept of end-to-end learning.

Fig 2:- Traditional Machine Learning Flow v/s Deep Learning Flow Model

There's no longer need of defining the features and do feature engineering. The neural do that for you. It can simply put in this way."If you want to teach a [deep] neural network to recognize a cat, for instance, you don't tell it to look for whiskers, ears, fur, and eyes. You simply show it thousands and thousands of photos of cats, and eventually it works things out. If it keeps misclassifying foxes as cats, you don't rewrite the code. You just keep coaching it". Though deep neural networks has its major drawbacks like, need of having huge amount of training data and need of large computation power, the field of computer vision has already conquered by this amazing tool already!

For this study secondary data has been collected. From the website of KSE the monthly stock prices for the sample firms are obtained from Jan 2010 to Dec 2014. And from the website of SBP the data for the macroeconomic variables are collected for the period of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE -100 Index is taken from yahoo finance.

V. Application of Computer Vision

Computer vision technology has many applications and it can be adopted by many industries in different ways. Some use cases are at the backend while others are more visible. Most probably you may have already used the products or services powered by computer vision application.[7]

Let have a look onto the few application of computer vision in different field.

➢ **Automotive Industry**

One of the most famous **applications of <u>computer vision</u>** is in the automotive industry. Technology giants like Google an Tesla are working on a full-fledged self-driving car. Features like Tesla's autopilot are available by using computer vision applications.

➢ **Retail**

Computer vision has also found **applications** in the retail sector also. For example, Amazon Go was opened up for the customers. It is a partially automated store that has no checkout stations or cashiers. By utilizing the computer vision, deep learning and sensor fusion, customers are able to exit the store without paying at the cash counter.

They will be charged for the products through their Amazon account. The technology is not 100% perfect yet as official tests have shown that some items were left out in the final bill. However, this is a revolutionary step in the right direction.

➢ **Financial Services**

Computer vision is not a revolutionary technology in the world of insurance and banking yet. Although some of the bigger players have implemented it in the on boarding of the new customers. In 2016, a Spanish bank introduced a new way of signing up for their services.

New customers can get a bank account within minutes by uploading a photo of their ID and selfie. The bank used **computer vision** to analyze the photos.

➤ **Healthcare**

In the healthcare sector, **computer vision** has the potential to bring in some real value. While computers won't completely replace the doctors and healthcare professionals, there is a good possibility that **computer vision** will assist in the diagnostics that require a lot of time and expertise. In this way, computers can serve as a helping tool for the healthcare sector.

➤ **Computer vision for preventive maintenance in Industries**

Companies are increasingly using the **computer vision** to monitor and report on the status of infrastructure critical to the operation of huge industrial complexes.

The list of facilities that use **computer vision** to alert humans for predictive maintenance is endless. Some of the platforms include the oil and gas industry chemical factories, petroleum refineries, and nuclear power plants.

➤ **Computer vision for Social Media**

Social media platforms are using **computer vision technology** for auto-tagging and adding image filters. For example, Snapchat uses the computer vision technology to apply a variable filter, Facebook uses computer vision to automatically tag the users in the images. Pinterest has a mobile **application** known as a lens that uses **computer vision**.
For example, if you point the app's camera to an object, it can display the objects similar to that object in styling and design.

VI. Future Scope of Computer Vision

The cognitive advancements in artificial intelligence are strengthening computer vision beyond human intelligence. Today, computer vision services are invading key business operations such as marketing, advertising, and customer services to deliver impactful insights and experience. It is, therefore, essential for emerging business ventures to capture the light of computer vision for achieving augmented business intelligence. [8]

➤ **Brand Monitoring and Expanded Tagging**

The object detection capabilities under AI development services are generating more business value while strengthening security. Today, businesses are extending the benefits of computer vision (CV) technology to different operations including brand awareness, marketing, and advertising.

Here's how computer vision is evolving within the digital business landscape-

a) With massive data inputs, computer vision systems can now **detect more objects per image** with better accuracy and precision.

➤ **Visual Question Answering**

Under deep learning, Visual Question Answering (VQA) enables a system to channelize image recognition and natural language processing (NLP) technologies for-

b) **Binary Classification**– Answering queries regarding the placement of objects in an image

c) **Tally**– Counting the number of specific subjects or objects

d) **Open-ended questions**– Inferring the object's spatial and contextual information

➤ **Computer vision applications in E commerce**

E-commerce is booming across the globe. One of the applications in e-commerce is automatic product categorization. When a new product is added to an e-commerce store, its attributes are automatically extracted using computer vision systems without the need for human intervention. This automates the process of labeling every new item that a store wants to add, allowing products to go up on the virtual shelves and into consumers hands' faster.

➤ **Computer vision applications in Banking**

Forward-thinking banks are using computer vision for implementing KYC (Know your customer) processes. This allows customers to open accounts using a selfie and a short video call. Computer vision technology is also used to identify customer emotions in order to

deliver actionable insights for the purpose of personalizing banking services across multiple channels. Increased customer satisfaction and ease of creating accounts have a direct impact on banks' revenues.

VII. Conclusion

A branch of artificial intelligence and image processing concerned with computer processing of images from the real world. Computer vision can be described as finding and telling features from images to help discriminate objects and/or classes of objects. The difficulty with this approach when the number of classes of the classification goes high or the image clarity goes down it's really hard to cope up with traditional computer vision algorithms. Hence we can conclude that Deep learning, which is a subset of machine learning has shown a significant performance and accuracy gain in the field of computer vision.

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